

吉林东部罗子沟盆地舌齿鱼科一新属

李国青

(中国科学院古脊椎动物与古人类研究所)

关键词 吉林汪清 早白垩世 大拉子组 舌齿鱼科

内 容 提 要

舌齿鱼科 (Hiodontidae) 以往只包括北美的两个属——现生舌齿鱼 (*Hiodon*) 和化石始舌齿鱼 (*Eohiodon*)。最近在吉林东部罗子沟盆地早白垩世大拉子组中发现的延边鱼 (*Yanbiania* gen. nov.) 与上述两属非常接近, 从尾骨结构和上下颌口缘、基舌骨齿板及副蝶骨腹侧着生牙齿的情况等方面来看, 它大概处在舌齿鱼科的早期发展阶段。这一发现, 为进一步探讨北美舌齿鱼类的起源和早期演化等问题提供了另一个重要的证据。

自从斋藤 (Saito, 1936) 建立满洲鱼 (*Manchurichthys*) 以来, 罗子沟盆地早白垩世大拉子组含油页岩段中所产脊椎动物化石一直以上床氏满洲鱼 (*M. uwatoki*) 为唯一

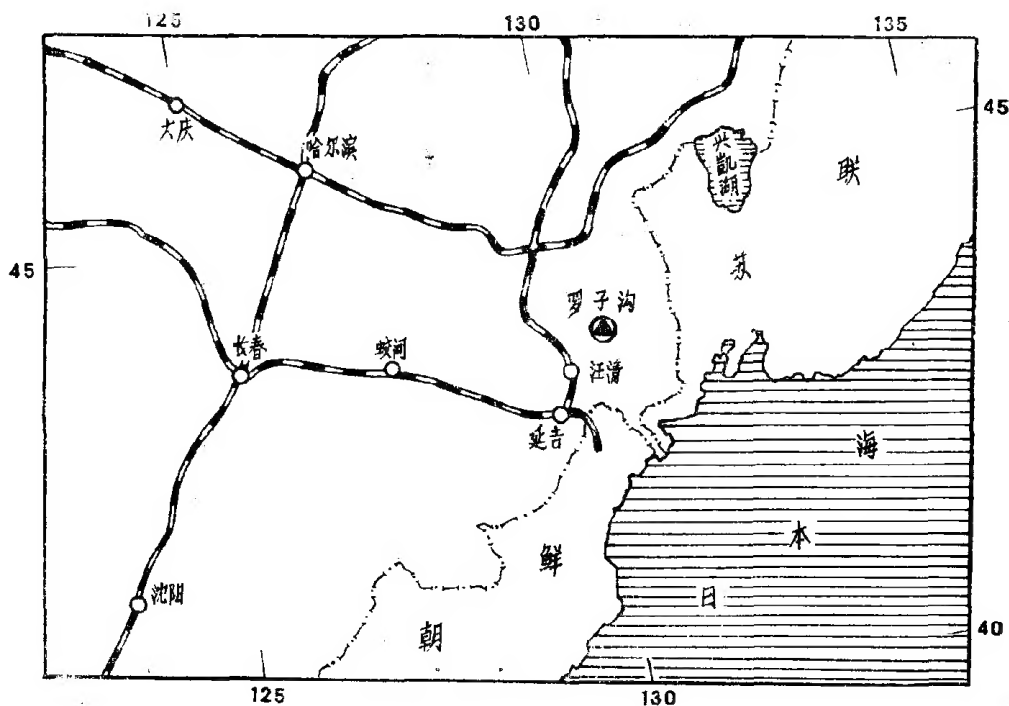


图1 罗子沟盆地交通位置图

Fig. 1 Map showing locality of Luoziyou Basin

代表。1978年,吉林省区域地质调查大队一分队在罗子沟地区(图1)进行1/20万区域地质调查过程中采得几块与上床氏满洲鱼不同的原始真骨鱼类化石,这一发现引起了人们的注意。1980年夏,我所马凤珍和本文作者专程赴该地工作,在张德英等的协助下,采得一批鱼化石标本。经笔者近年来的观察和先后两次分别与吴光中、金帆去罗子沟补点作业,目前对这批化石已有一个初步的认识。现知,罗子沟盆地大拉子组含油页岩段除了产有原始真骨鱼类(Euteleostei)满洲鱼(张弥曼等,1977)外,尚有属于弓鳍鱼目(Amiiformes)的罗子沟中华弓鳍鱼(*Sinamia luozigouensis*) (李国青,1984)以及本文记述的属于骨舌鱼超目(Osteoglossomorpha)的延边鱼(*Yanbiania* gen. nov.)。这后两类鱼产于同一化石层中;满洲鱼则在两者的上下岩层中均有发现(以上部岩层中最多)。据此可以基本肯定,这三种鱼大致生活在同一时代。

从骨骼特征上来看,延边鱼与似狼鳍鱼(*Plesiolycopera*)和始舌齿鱼、舌齿鱼最接近,由此推测它是舌齿鱼科的一个早期成员。它的发现,丰富了吉林东部早白垩世的鱼群组合;也为进一步讨论北美舌齿鱼类的起源等问题提供了新的资料。

一、标本记述

骨舌鱼超目 Osteoglossomorpha

舌齿鱼目 Hiodontiformes Taverne, 1977

舌齿鱼科 Hiodontidae

延边鱼属(新属) *Yanbiania* gen. nov.

特征 体呈梭形。头部感觉管系统似古鳕科,眶上管终止于顶骨的后侧部,不与眶下管相连。上枕骨不插入两顶骨间。两顶骨在中线相接,其表面有向后呈“r”形展布的浅沟。额骨长大。有一块眶前骨和六块眶下骨,但无眶上骨。副蝶骨腹侧着生粗大的尖锥形齿,前部一排,后部至少两排。辅上颌骨缺如。口裂大。齿骨冠状突不发育。上颌骨、前上颌骨及齿骨的口缘着生众多的尖锥形齿。鳃盖骨大,略呈平行四边形;下鳃盖骨小;前鳃盖骨下枝后缘后突,分裂成梳状;鳃条骨不少于七对。基舌骨齿板背面观呈梭形,沿其边缘着生粗壮的锥形齿。椎体圆筒状,44—46枚;有上神经棘和上髓弓小骨。胸鳍位低,向后不伸达腹鳍;腹鳍腹位,比胸鳍小;背鳍起点居臀鳍起点之前;臀鳍起点略后于背鳍基之中点;背鳍和臀鳍几等大;尾鳍分叉中等深,上下叶各有八根分叉鳍条。有两个上扬的末端尾椎。尾下骨七块;尾神经骨三至四根;一块尾上骨;第一尾前椎有完整的神经棘,第一末端尾椎则无此棘。圆鳞,核稍偏后,仅基部(复压区)可见放射纹。

汪清延边鱼 *Yanbiania wangqingica* gen. et sp. nov.

(图版 I—III, 图 2-4)

特征 同属的特征。体长约为体高的3.5—4.2倍,头长约为头高的1.2倍;背鳍前距约占体长的0.6—0.7。椎体多达46枚,躯椎和尾椎数相等。鳍式: P12; V7; D iv, 11—12; A v, 11—12; C i, 8, 8, i。分别约有12根和10根附属鳍条位于尾鳍上下缘不分叉主鳍条的前方。

正型标本 一条完整的鱼, 仅颞区和眶区骨片破损。古脊椎动物与古人类研究所标本登记号 V6767.1 (图版 I)。

其他标本 七条外形基本完整、头骨严重破损的鱼 (V6767.2, V6767.3, V6767.4, V6767.5, V6767.6, V6767.7, 罗: 85001); 一缺失尾部的个体 (V6767.8) 和一保存有部分眶下骨的不完整个体 (V6767.9); 一破碎的头骨 (V6767.12) 和一单个鳃盖 (V6767.10) 以及一对分离的匙骨 (V6767.11)。

产地及层位 吉林省汪清县罗子沟农场北沟分场南偏东约 600 米处; 大拉子组含油页岩段, 早白垩世。

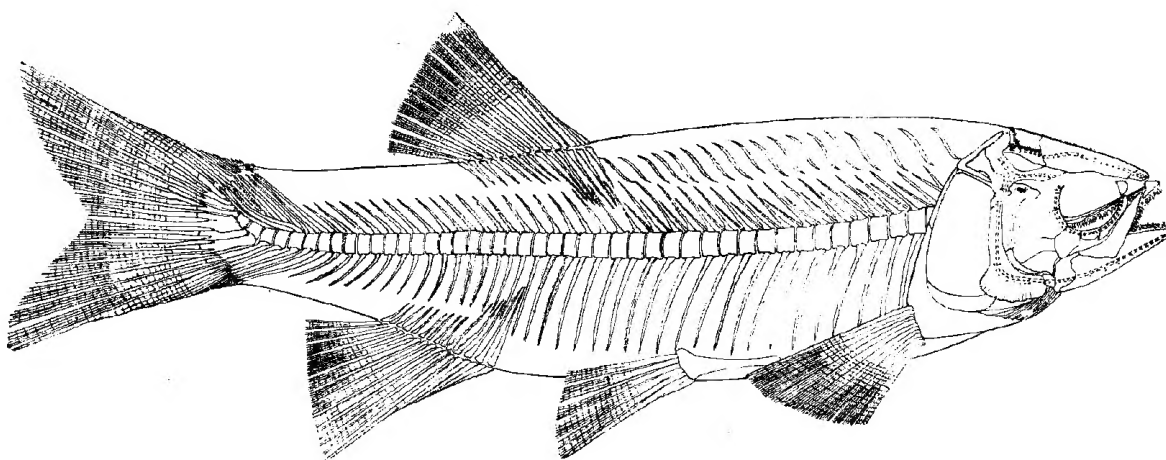


图2 汪清延边鱼(新属、新种)的复原图, 主要根据 V6767.1, V6767.2, V6767.8, V6767.9, V6767.10
Fig. 2 Restoration of *Yanbiania wangqingica* gen. et sp. nov., mainly based on V6767.1, 2, 8, 9 and 10

描述 体呈长梭形。体长一般为 10 厘米左右, 也有达 20 厘米的 (V6767.9); 最大体高位于腹鳍处。体长约为体高的 3.5—4.2 倍, 个别可超过 4.4 倍。背鳍前距约占体长的 0.6—0.7。

头骨 (图版 I—II; 图 3) 头长约为头高的 1.2 倍。颅顶后部破损, 不能确认上枕骨的形状, 但它显然不插入两顶骨间。两顶骨在头顶中线相接, 其前部与额骨后部等宽, 后部稍窄; 后缘明显凹入, 在后侧角形成一锥状突; 其表面有向后呈“r”形展布的浅沟, 此沟的分叉处有一眶上感觉管的开孔 (V6767.1)。额骨长大, 前部稍窄于后部, 其在眼眶上方不明显变窄; 两额骨在颅顶几以直线相接, 其表面有感觉管通过的部位隆起成脊, 此脊突之前 2/3 与额骨之接合线平行, 后 1/3 外展而与顶骨上的隆脊相连, 穿行于其内的眶上感觉管最后在顶骨后侧角锥状突基部的前方以孔与外界相通。V6767.1 额骨前接两块界线不清的骨片, 可能为破损的鼻骨 (有眶上感觉管通过) 和中筛骨 (居于中线者)。单块鼻骨可见于 V6767.9 上, 其状如梭, 有感觉管通过。V6767.1 可见一破碎的膜质翼耳骨, 其前部伸达额骨的后下方, 后部似分成两枝, 一枝斜向后背方接上颞骨, 另一枝向下接前鳃盖骨和舌颌骨; 相应地, 其上的感觉管亦成三射状展布。上颞骨略呈马蹄铁形, 它包围了顶骨的后侧角; 此骨与顶骨和膜质翼耳骨的合围处尚有一孔隙, 从位置上来判断, 该孔隙与狼鳍

鱼 (*Lycoptera*) 和舌齿鱼的颞孔相当, 据此推测, 这种鱼可能具有颞孔。后颞骨呈叉状, 上枝长于下枝, 上下两枝夹角近 60° 。

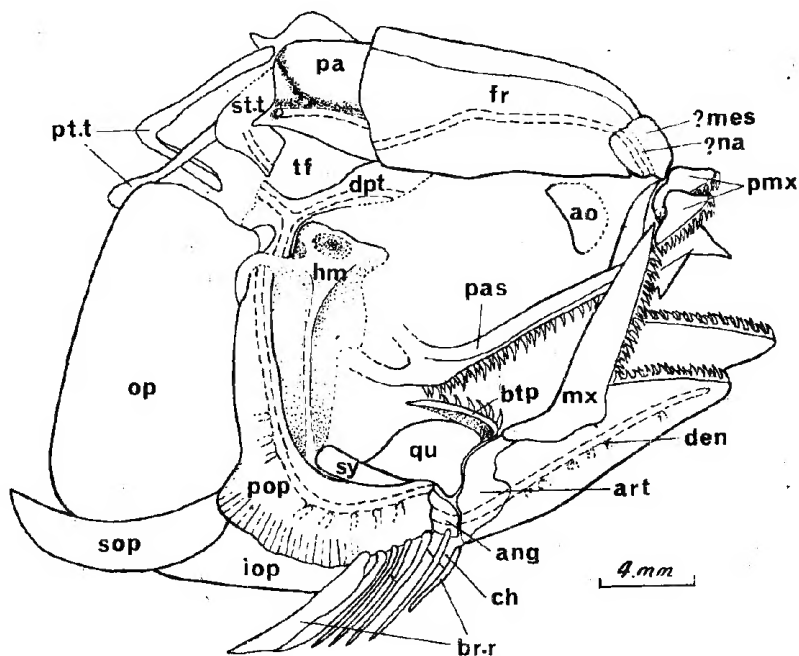


图3 汪清延边鱼的头骨, 简字说明见附注

Fig. 3 Skull of *Yanbiania wangqingica* gen. et sp. nov., from V6767.1, right side view. Abbreviations used in figure are arranged in appendix

头部感觉管分布同古鳕科。眶上管终止于顶骨的后侧部; 不与眶下管相连。

眼眶大, 前后径约当头长的 $1/4$ 。眶上骨缺如。眶前骨一块, 略呈半圆形, 其上无感觉管 (V6767.4, 12)。从 V6767.9 可知, 这种鱼有六块眶下骨 (包括膜质蝶耳骨), 其中以第二块最小, 紧接窄长的泪骨 (第一眶下骨); 第三块稍大, 后部复于方骨之上; 第四块缺损后部, 估计其后缘可达续骨之前上方; 第五、六块 (膜质蝶耳骨) 虽仅保存感觉沟部分, 但两者界线可据此而定 (图版 II:1)。眶下感觉沟沿各眶下骨之近眶缘通过。

扇形的方骨以发达的关节头与下颌相关节。续骨呈长条状 (V6767.1 和 V6767.9), 它与方骨重叠的部分约为其长度的 $1/2$ 。翼骨区破损, 标本上仅见该部残缺的锥形齿痕迹。副蝶骨粗壮, 轻度弧弯, 未见基翼突; 此骨腹侧着生粗大的锥形齿, 前部一列, 后部至少有两列 (V6767.8)。

口裂大, 略斜向前上方。上颌骨长而强壮, 自后向前渐收缩, 其前端贴接于前上颌骨的后背方。未见辅上颌骨。前上颌骨小, 略呈三角形, 其背部有一高的丘状突; 它和上颌骨一起组成口裂上缘, 并和上颌骨一样, 在口缘生有众多的尖锥形齿。下颌由发达的齿骨、关节骨和隅骨组成 (V6767.1, V6767.9)。齿骨口缘往后渐抬高, 但不形成明显的冠状突, 参与组成口裂下缘的部分同样生有众多的尖锥形齿; 齿骨下部有感觉管通过的部位隆起成脊, 在此隆脊的下方有 4—5 个感觉管的开孔。关节骨呈复杂的多边形, 它的前部嵌

入齿骨内侧,下部表面隆起,供下颌管通过;其后上缘明显下凹,与隅骨之略向下凹的前上缘联合构成一半球形关节面,以接纳方骨之发达的关节头。隅骨略呈斜方形,前鳃盖管经由此骨而与下颌管相连。

鳃盖骨大(图版 II:4),略呈各角圆钝(尤以后下角最明显)的平行四边形,其表面有极微弱的同心纹和放射纹;从 V6767.8, 10 两块标本上测得此骨之高约为其上下缘平均宽度的两倍。下鳃盖骨小,几为弯月形。前鳃盖骨上枝稍长于下枝,下枝则远比上枝宽;此骨的后下角明显地向后突出,其圆突的边缘分裂成梳状(V6767.2, 3, 6, 8);上下枝夹角约为 90° ;前鳃盖感觉管在下枝部向下发出 5 至 6 个分枝。间鳃盖骨大小近于下鳃盖骨。

在 V6767.1 和 V6767.8 上保存有不完整的舌颌骨,其主杆外表有发达的中脊,在中脊的上方有一孔,根据 Taverne (1977, 图 2, 15, 30) 对始舌齿鱼和舌齿鱼之舌颌骨的注解,此孔应该与面神经舌颌枝(truncus hyoidesmandibularis)的通孔有关。舌颌骨下端中脊部与续骨相连。角舌骨前后宽扁,中部收缩,侧视呈双凹镜状,其前端窄于后端。V6767.4 之角舌骨的前方可见略呈椭圆形的下舌骨。在 V6767.2, 3, 4 的头部腹侧,保存有破损的基舌骨齿板,该齿板背面观呈长梭形,沿其边缘着生粗壮的锥形齿(图版 II:3)。

肩带 肩带以匙骨最为强壮(图版 II:5),此骨呈镰形,分长度和宽度几相等的上下两枝,其表面发育有粗壮的隆脊(与上下枝平行)。上匙骨呈棒状,其上端接后颞骨的分叉部,下端多少嵌入匙骨。

脊柱(图版 I, III; 图 2) 脊椎骨化完全,由 44—46 枚椎体组成,其中,躯椎和尾椎数相等。单个椎体高约为其长的两倍,外观圆筒形,中间略收缩,侧面有若干侧脊(5 个以上)。脊索穿孔大,呈线轴形。最前部被鳃盖复掩的 2—3 枚椎体互不愈合,也不特化。在 V6767.7 的尾部可见双椎结构。全部躯椎上的神经弧不愈合。在神经弧基部的后侧有上髓弓小骨发出。自背鳍前至上匙骨后缘,可见一列(至少 17 根)细长的、两端尖削的上神经棘,它们依次位于第一枚至背鳍支持骨前各躯椎之神经弧的后背方。肋骨细长,伸达近腹缘。全部尾前椎上的髓弓和脉弓均愈合并伸长成棘。

显然有两个上扬的末端尾椎与 7 块尾下骨相连。正常状态的尾骨结构与始舌齿鱼和舌齿鱼等相同(图 4),其第一、二尾下骨关节于第一末端尾椎;第二末端尾椎则与第三至第七尾下骨相连。第一尾下骨最宽最长,近端与椎体关节之头很发达;其表面有一自关节头中部向后方斜贯于此骨的凹槽。第二尾下骨宽度约等于第一尾下骨,但关节头远不如后者发达;其表面有轻微的脊状隆起。第三至第七尾下骨的长度和宽度依次递减。全部尾下骨彼此间互不愈合,亦不与末端尾椎相愈合,它们与尾鳍条之间的关系如图 4 所示。有 3 至 4 根细长的尾神经骨;其中,第一根前伸可达第三尾前椎的前背缘,其后各根的前端也均超过第二末端尾椎(见图 4)。第一尾前椎同其以前的椎体一样,发育有完整的神经棘,在此神经棘与第一尾神经骨之间,有一根细棒状的尾上骨(见 V6767.1, 2, 5, 7)。第一末端尾椎则不发育有神经棘。有五个尾前椎的脉棘和神经棘伸长与尾下骨和尾神经骨一起支持尾鳍的上叶和下叶,这些髓棘和脉棘的基部均不与椎体相愈合。

鳍 胸鳍位低,向后不伸达腹鳍起点,由约 12 根远端分节分叉的鳍条组成。腹鳍腹位,比胸鳍小,鳍条 7 根,第一根短,不分节亦不分叉;第二根硕壮,分节而不分叉,这些鳍

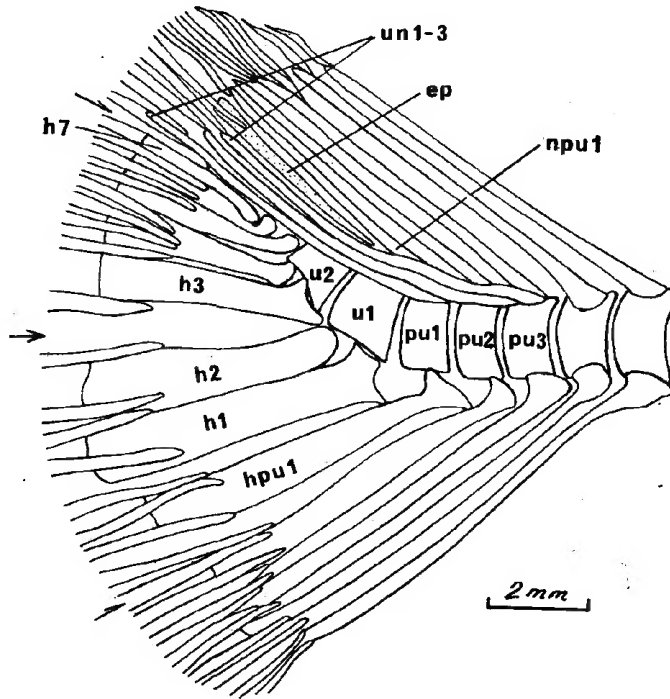


图4 汪清延边鱼的尾骨,按 V6767.1 复原

Fig.4 Caudal skeleton of *Yanbiania wangqingica* gen. et sp. nov., from V6767.1.

Abbreviations used in figure are given in appendix

条被一粗壮的棒状鳍基骨所支持;此鳍距臀鳍略近于胸鳍。背鳍基短,起点居于臀鳍起点之前,鳍条 IV, 11—12 根;可观察到的支持骨一般为 14 根。臀鳍大小与背鳍相近,且同为三角形,其起点与背鳍基的中点相对或稍偏后,鳍条 V, 11—12。尾鳍外观对称,分叉中等深,上叶和下叶各有 8 根分叉主鳍条;此外,分别约有 12 根和 10 根附属鳍条 (pre-current rays) 位于上下缘不分叉主鳍条的前方。

鳞 体披圆鳞。单个鳞片可见于 V6767.9 上,高稍大于长,其表面有致密的生长纹,

表1 标本测量
Measurements of specimens(单位: 毫米)
(in mm)

	V6767. 1	V6767. 2	V6767. 3	V6767. 4	V6767. 5	V6767. 6	V6767. 7
全长 (Total length)	127	92	98	93	94	87	77
体长 (Body length)	105	75	84	81	76	72	66
体高 (Body depth)	29	21	20	23		17	15
头长 (Head length)	31	20	21	22	21	17	16
头高 (Head depth)	26	17	18	19	18	14	13
背鳍前距 (Predorsal length)	65	44	48	54	46	44	38
臀鳍前距 (Preanal length)	80	58	54	62	55	50	44
尾柄长 (Caudal peduncle length)	22	13	16	13	17	15	15
尾柄高 (Caudal peduncle depth)	13	8.5	9	11	13	7.6	7

这些同心纹的核偏后;鳞片的基部(复压区)见有微弱的放射纹。

二、比较和讨论

(一) 本文所描述的罗子沟标本在方骨关节面的组成、上颌骨与前上颌骨的连接方式、上枕骨不插入两顶骨间和具有六块眶下骨等一般特征上,可与狼鳍鱼和同心鱼(*Tongxinichthys* Ma, 1980)等作比较。但它在另一些重要特征上则更接近始舌齿鱼(Cavender, 1966; Taverne, 1977)和舌齿鱼(Ridewood, 1904; Greenwood, 1970; Taverne, 1977),如:几乎完全一致的尾骨结构(见图4),梭形的、主要沿边缘生齿的基舌骨齿板,缺失辅上颌骨和眶上骨,鳞上放射纹只见于基部等等。然而,罗子沟标本至少在以下几个方面可与上述各属相区别:

- 1) 背鳍和臀鳍几乎等大,且同为三角形。
- 2) 顶骨的后侧角向后成锥状突起,在其表面有向后呈“r”形展布的浅沟。
- 3) 额骨略成长方形,其在眼眶以上部分不明显变窄。
- 4) 前上颌骨的背部有一高的丘状突。
- 5) 鳃盖骨近于平行四边形;前鳃盖骨下枝的后缘明显地向后突出,其圆突的边缘分裂成梳状。
- 6) 上下颌口缘的牙齿较上述各属更多。
- 7) 眶上感觉管终止于顶骨的后侧部。

有必要指出的是,罗子沟标本在体形和鳃盖系各骨及齿骨、上颌骨的形状上酷似亚洲鱼(*Asiatolepis* Takai, 1943)。众所周知,由于高井东二据以确定此属的两个主要性状(缺失肌间骨和末端尾椎不上扬)并不存在,亚洲鱼也因此一度被废弃而重被归入狼鳍鱼属中(刘宪亭等, 1963)。1976年,张弥曼、周家健根据中华狼鳍鱼(*Lycoptera sinensis* Woodward, 1901)可能缺失颞孔和具有15根分叉尾鳍条等特征,重新确立了亚洲鱼属。基于对部分中华狼鳍鱼标本的观察,可以认为,恢复亚洲鱼是必要的。因为,亚洲鱼除了颞孔是否存在尚待证实外,它有辅上颌骨而无眶上骨,尾下骨只有六块,缺失尾上骨,第一末端尾椎上发育有完整的神经棘,其尾鳍分叉主鳍条为15根等特征(V367.; 图5)是基本可以肯定的。这些性状,显然很不同于狼鳍鱼,也有别于罗子沟标本。

通过以上比较,笔者认为,罗子沟标本代表原始骨舌鱼类一新属,现依其化石产地所在区,命名为汪清延边鱼(*Yanbiania wangqingica* gen. et sp. nov.)。这种鱼与罗子沟中华弓鳍鱼共生,一起发现的还有介形类柔星介(*Cyprois*) (勾韵娴鉴定)和植物鲁福德蕨(*Ruffordia*)、假拟节柏(*Pseudofrenelopsis*) (周志炎、孙革鉴定)等。由这些共生生物的时代分布可知,延边鱼的生存时代当以早白垩世为主,也可能延存至晚白垩世的早期。而罗子沟中华弓鳍鱼和柔星介等均为淡水型生物,可以肯定,延边鱼也为淡水鱼类。

顺便提一下,延边鱼与邻近地区蛟河盆地早白垩世(含满洲鱼)地层中发现的蛟河鱼(*Jiaohichthys* Ma, 1983)也有某些相似之处,如:可能都具有颞孔,口裂上下缘,副蝶骨腹侧及基舌骨齿板上均具齿,七块尾下骨等等。但两者在鳃盖骨和前鳃盖骨的形状及尾骨总的构造上的差异却是显而易见的(见图6)。

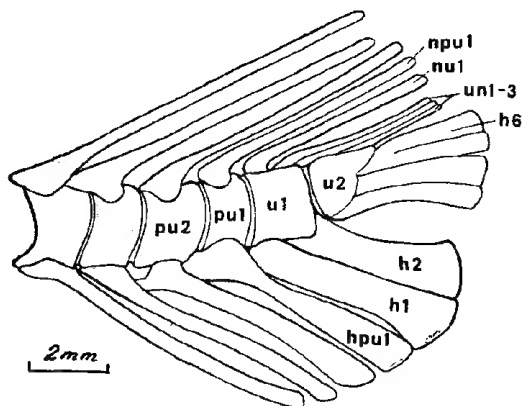


图5 中华亚洲鱼的尾骨, 依 V367

Fig. 5 Caudal skeleton of *Asiatrolepis sinensis* (Woodward) Takai, based on V367.; abbreviations used in figure are given in appendix

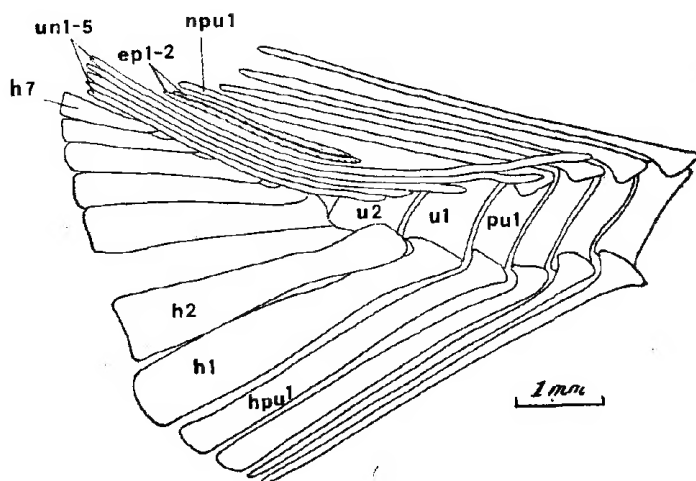


图6 美丽蛟河鱼的尾骨, 依 V6186. 1a

Fig. 6 Caudal skeleton of *Jiaohichthys pulchellus* Ma, drawn from V6186.1a

(二) Greenwood(1970) 认为, 可与延边鱼比较的狼鳍鱼、始舌齿鱼和舌齿鱼是同一系列中关系十分亲近的成员。前者在中生代后期(晚侏罗世—早白垩世)曾广布于东亚地区, 后者则为北美内陆河湖之现生类群; 始舌齿鱼在过去通常被认为是舌齿鱼科的真正的化石代表, 它迄今为止只发现于北美的始新世地层中 (Cavender, 1966; Wilson, 1978; Grande, 1979, 1984)。但从始舌齿鱼所具有的与舌齿鱼几乎完全一致的骨骼特征来看, 它似不大可能是舌齿鱼科的最早成员。前不久, 张弥曼、周家健 (1976) 描述了一类产自我国大庆油田白垩纪中期地层中的似狼鳍鱼 (*Plesiolycopera*), 从它不具有辅上颌骨和眶上骨, 有五块眶下骨 (图7)、臀鳍基较长等性状推测, 这种鱼无疑与始舌齿鱼和舌齿鱼已很接近。张、周曾根据上述各属的相近特征及地理分布, 拟绘了一幅狼鳍鱼—似狼鳍鱼—

表 2 舌齿鱼目各属之间部分特征对比表
Showing some of the similarities and differences among the genera of Hiodontiformes

比较项目 属 名	颞孔	眶上骨 (块)	眶下骨 (块)	辅上颌骨 (块)	舌颌骨与脑颅的关节头	第一尾前椎上的神经棘	第一末端尾椎上的神经棘	尾上骨 (块)	尾神经骨 (根)	尾下骨 (块)	椎体数 (枚)	鳍条数(根)		
												背鳍	臀鳍	尾鳍分叉鳍条
<i>Hiodon</i>	有	0	5—6	0	双头	完整	缺如	1	3—4	7	55—61	9—12	23—32	16
<i>Eohiodon</i>	有	0	5—6	0	双头	完整	缺如	1	3—4	7	47—49	12—17	18—26	16
<i>Plesiolycopera</i>	有	0	5	0	?	完整	缺如	1	?	?	>40	14	24	16
<i>Yanbiania</i> gen. nov.	有	0	6	0	?	完整	缺如	1	3—4	7	44—46	16	16	16
<i>Lycopera</i>	有	1	6	1	单头	完整	发育不全	1	3—4	7	40—43	~11	~13	16
<i>Tongxinichthys</i>	有	1	6	1	单头	完整	发育不全	1	3—4	7	43—46	16—17	20—21	16

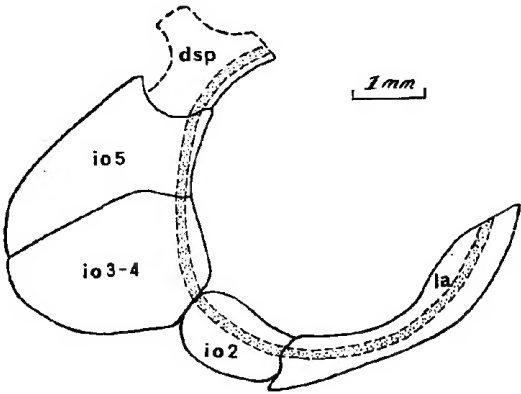


图 7 大庆似狼鳍鱼的眶下骨,根据 V4743. 1
Fig. 7 Infraorbitals of *Plesiolycopera daqingensis*, based on V4743.1

始舌齿鱼—舌齿鱼序列系统图(1976:图 4),首次用枝序分散法(cladistic dispersal method, Patterson, 1981, p. 273)表明了狼鳍鱼朝舌齿鱼方向的演化关系。

由表 2 可知,延边鱼在很多方面(尤其是它的尾骨骼)确实与狼鳍鱼、似狼鳍鱼和始舌齿鱼、舌齿鱼等非常接近或相一致,据此可以基本确定它是狼鳍鱼——舌齿鱼序列的成员之一。它在吉林东部的发现,似乎使我们找到了连接狼鳍鱼朝舌齿鱼方向发展的一个早期环节。有理由推测,延边鱼所具有的某些狼鳍鱼的特征说明它与狼鳍鱼之间或许存在着系统发生上的关系。换句话说,它很可能是从一个与狼鳍鱼有密切关系的近祖演化来的。而延边鱼所具有的始舌齿鱼和舌齿鱼的性状则又表明,它很可能已经处在似狼鳍鱼和始舌齿鱼、舌齿鱼的共同的近祖阶段了。

这里需要指出的是,延边鱼与始舌齿鱼和舌齿鱼之间的关系可能要比它与狼鳍鱼的关系更密切些。原因是,现生舌齿鱼和化石始舌齿鱼所具有的某些重要性状可能是从延边鱼这个阶段开始出现或基本定型的,如:眶上骨和辅上颌骨的消失,梭形的、主要沿边缘生齿的基舌骨齿板(Nelson, 1968; Taverne, 1977),独特的、不同于几乎所有其他真骨鱼类(Whitehouse, 1910; Gosline, 1960; Greenwood, 1966; Nybelin, 1971, 1974; Patterson et Rosen, 1977; Grande, 1985)的尾骨结构等等。此外,延边鱼口缘和副蝶骨腹

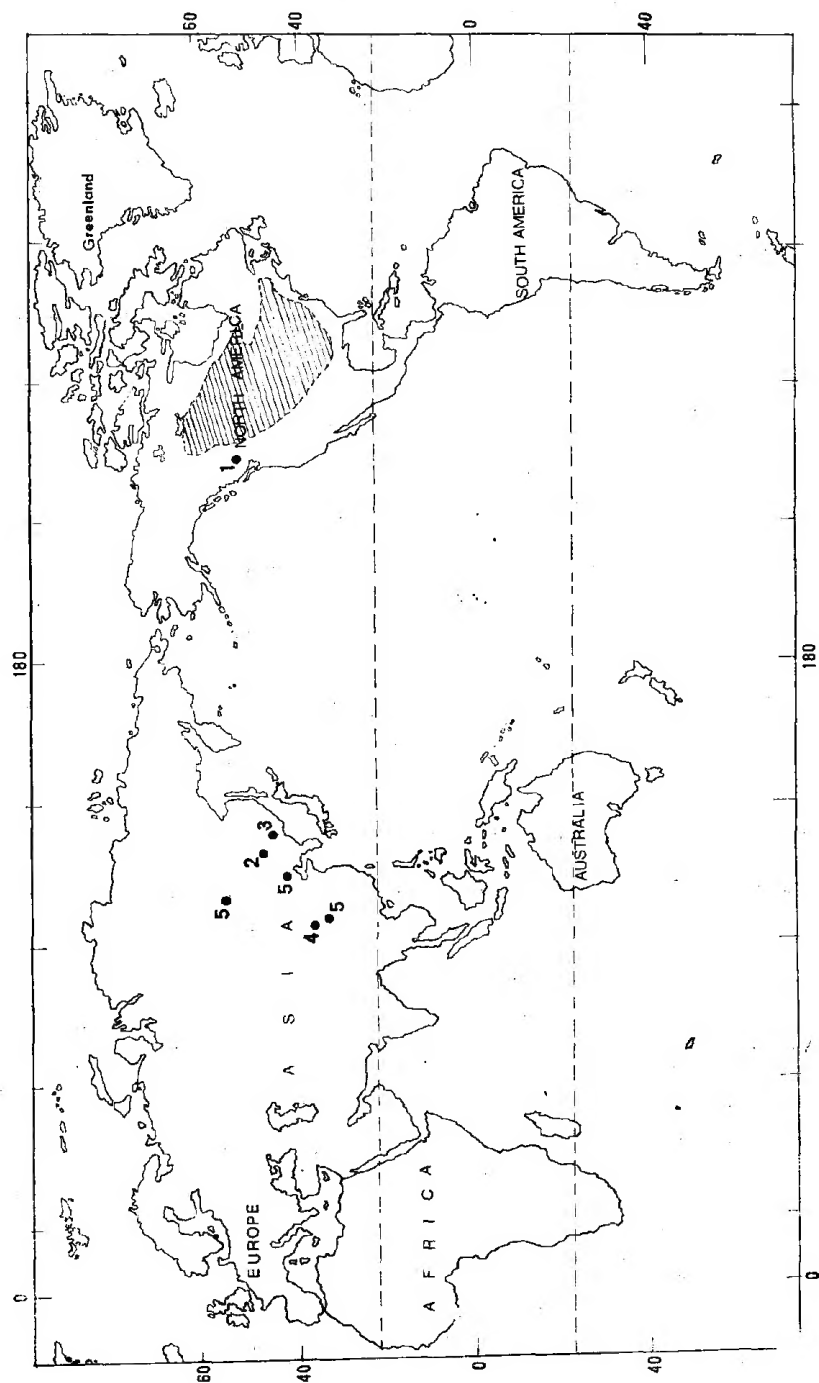


图 8 舌齿鱼目的地理分布
 Fig. 8 Distribution of Hiodontiformes. ▨ Recent *Hiodon*; ● fossil localities: 1. *Eohiodon*, 2. *Plesiolycoptera*, 3. *Yanbiania* gen. nov., 4. *Tongxinichthys*, 5. *Lycoptera*

侧着生牙齿的情况与始舌齿鱼和舌齿鱼也已非常接近;其椎体数和臀鳍条数亦似乎正处在狼鳍鱼向始舌齿鱼和舌齿鱼演化的转折点上。所有这些迹象表明:延边鱼大致已经处在舌齿鱼科的早期演化阶段。据此,笔者认为,延边鱼可以归入舌齿鱼科中。

(三)前面已经谈到,延边鱼在吉林东部的发现,使我们找到了一个连接狼鳍鱼朝现生舌齿鱼方向发展的早期(狼鳍鱼与似狼鳍鱼之间)环节。从狼鳍鱼—延边鱼—似狼鳍鱼—始舌齿鱼—舌齿鱼序列上可以看到,狼鳍鱼向舌齿鱼的演化经历了由晚侏罗世至现代的漫长岁月,在此过程中,它们的形态特征虽然发生了一系列变化,但彼此之间仍然保留着相对的统一性(见 Greenwood, 1970),这跟它们之间在地理分布上的差异形成了鲜明的对照。

Nelson (1969) 曾经认为,现生舌齿鱼(以及全部现生骨舌鱼类)最早起源于冈瓦纳大陆(非洲),以后才次生性地分布(迁徙)到北美大陆上。Greenwood (1970) 和张弥曼、周家健 (1976) 则根据对于狼鳍鱼和舌齿鱼的详细研究后指出:北美现生舌齿鱼最早很可能起源于亚洲。由于 Nelson 的推论缺乏古生物和古动物地理方面的证据,因而不能合理地解释有关现生舌齿鱼分布区形成的历史原因。

大家知道,与舌齿鱼相近的狼鳍鱼迄今为止只发现于华北、蒙古和苏联东西伯利亚(贝加尔湖以东)地区的晚中生代河湖相沉积中,这一区域大致处在北纬 35° — 60° , 东经 95° — 135° 的范围内。最近发现的、与狼鳍鱼和舌齿鱼可资比较的同心鱼、似狼鳍鱼和延边鱼等也均处在此区域内(图 8)。已经发现的始舌齿鱼的化石点则仅限于北美大陆的西部地区 (Cavender, 1966; Wilson, 1978; Grande, 1979, 1984); 现生舌齿鱼则主要分布在北美内陆地区的温带水域内(图 8)。这些事实说明,在由狼鳍鱼向北美现生舌齿鱼的发展过程中,它们的分布区也发生了由西向东的迁徙。这种迁徙,可能与全球构造运动有关系。如此看来,舌齿鱼最早起源于亚洲的推论是能够成立的。

依据对现有资料的分析,在狼鳍鱼、延边鱼和似狼鳍鱼生存的时代(晚侏罗世—晚白垩世),东亚大陆西部有土尔盖海峡 (Turgai Strait) 与欧洲相隔,南部有特提斯海 (Tethys Sea) 与非洲、印度等陆块相隔 (Pielou, 1979, pp. 26—64), 这些障碍无疑阻止了狼鳍鱼及其后裔向西和向南的扩散。上述隔离一直持续到新生代早期,这恐怕也就是为什么至今没有在非洲、欧洲和印度等地区发现与狼鳍鱼形态接近,时代相同的化石原始真骨鱼类的主要原因。而狼鳍鱼或延边鱼的后裔侵入北美的时间很可能在白垩纪末期和早第三纪早期。换言之,在这段时间内,东亚大陆与北美大陆之间有过联系。这种联系并且不大可能是陆链 (island chain) 或跳板 (stepping stone islands) 式的,因为,这类通道或多或少还有海水相隔。对于淡水生活的狼鳍鱼、延边鱼及其后裔来说,即便是很狭窄的海域都可能成为无法通过的障碍。而要沟通东亚和北美两大陆块上的淡水水域,必须有陆桥或较大面积的陆块接合才能实现。就此意义而言,狼鳍鱼—延边鱼—似狼鳍鱼—始舌齿鱼—舌齿鱼演化序列同时还证明,白垩纪末期至早第三纪早期,亚洲东北部与北美西北部之间曾经由“白令陆桥”相连的假设也是可信的。进一步工作,或许能够获得更多的、关于“北美鱼类区系发展” (Patterson, 1981) 的历史动物地理学信息。

本文在刘宪亨导师的指导下完成。在写作过程中,得到了张弥曼的热心指教和鼓励;苏德造、周家健等帮助审阅初稿并提出许多宝贵的建议;盖培帮助查阅俄文资料;侯晋封、

张杰绘图和照相,笔者在此深深致谢!此外,我还要感谢南京地质古生物所周志炎、勾韵嫔、孙革三位先生鉴定植物和介形类化石!感谢吉林区调队张德英、刘爱等在野外工作中所给予的帮助和他们发现化石层的创造性劳动!

(1986年3月4日收稿)

插图简字说明 Abbreviations used in figures

ang	angular	隅骨
ao	antorbital	眶前骨
art	articular	关节骨
br.r	branchiostegals	鳃条骨
btp	basihyal tooth plate	基舌齿板
ch	ceratohyal	角舌骨
cl	cleithrum	匙骨
cor. p	coronal process	冠状突
den	dentary	齿骨
dpt	dermopterotic	膜质翼耳骨
dsp	dermosphenotic	膜质蝶耳骨
ep	epural	尾上骨
fr	frontal	额骨
h	hypurals	尾下骨
hm	hyomandibular	舌颌骨
hpul	haemal spine of 1st preural	第一尾前椎上的脉棘
io	infraorbitals	眶下骨
iop	interoperculum	间鳃盖骨
la	lacrimal	泪骨
mes	mesethmoid	中筛骨
mx	maxilla	上颌骨
na	nasal	鼻骨
npul	neural spine of 1st preural	第一尾前椎上的神经棘
op	operculum	鳃盖骨
pa	parietal	顶骨
pas	parasphenoid	副蝶骨
pc. r	precurrent rays	附属鳍条
pmx	premaxilla	前上颌骨
pop	preoperculum	前鳃盖骨
pt. t	post-temporal	后颞骨
pul—3	1st to 3rd preural centra	第一至第三尾前椎
qu	quadrate	方骨
scl	supracleithrum	上匙骨
sop	suboperculum	下鳃盖骨
st. t	supratemporal	上颞骨
sy	symplectic	续骨
tf	temporal fenestra	颞孔
u1,u2	1st and 2nd ural centra	第一和第二末端尾椎
un1—3	uroneurals	尾神经骨

参 考 文 献

- 马凤珍, 1980: 宁夏狼鳍鱼科一新属。古脊椎动物与古人类, 18(4), 286—295。
 —— 1983: 吉林蛟河盆地早白垩世原始真骨鱼化石及其在地层上的意义。古脊椎动物与古人类, 21(1), 17—31。
 刘宪亭、苏德造、黄为龙、张国瑞, 1963: 华北的狼鳍鱼化石。中国科学院古脊椎动物与古人类研究所甲种专刊第六

号。

- 李国青, 1984: 中华弓鳍鱼在吉林东部的发现。古脊椎动物学报, 22(2), 145—150。
- 张弥曼、周家健, 1976: 松江盆地似狼鳍鱼属的发现及骨舌鱼超目的起源。古脊椎动物与古人类, 14(3), 146—153。
- 张弥曼、刘智成, 1977: 两个原始的真相骨鱼 (Euteleostei)——满洲鱼和松花鱼。古脊椎动物与古人类, 15(3), 184—193。
- 张弥曼、周家健、刘智成, 1977: 东北白垩纪含鱼化石地层的时代和沉积环境。古脊椎动物与古人类, 15(3), 194—197。
- Cavender, T., 1966: Systematic position of the North American Eocene fish "*Leuciscus*" *rosi* Hussakof. Copeia, 1966, 311—320.
- Gosline, W. A., 1960: Contributions toward a classification of modern isospondylous fishes. Bull. Brit. Mus. Nat. Hist. (Zool.), 6, 325—365.
- Grande, L., 1979: *Eohiodon falcatus*, a new species of hiodontid (Pisces) from the late Early Eocene Green River Formation of Wyoming. Journ. Paleont., 53, 103—111.
- , 1984: Paleontology of the Green River Formation, with a review of the fish fauna. Bulletin 63, Wyoming Geological Survey: 1—334. (Second Ed.).
- , 1985: Recent and fossil clupeomorph fishes with materials for revision of the subgroups of clupeoids. Bull. Amer. Mus. Nat. Hist., 181, Art. 2, 231—372.
- Greenwood, P. H., 1966: The caudal fin skeleton in osteoglossoid fishes. Ann. Mag. Nat. Hist., 9, Ser. 13, 581—597.
- , 1970: On the genus *Lycoptera* and its relationship with the family Hiodontidae (Pisces, Osteoglossomorpha). Bull. Brit. Mus. Nat. Hist. (Zool.), 19(8), 257—285.
- McAllister, D. E., 1968: Evolution of branchiostegals and classification of teleostome fishes. Bull. National Mus. Canada, No. 221, Biol. Ser. No. 77, 1—239.
- Nelson, G. J., 1968: Gill arches of teleostean fishes of the division Osteoglossomorpha. Journ. Linn. Soc. (Zool.), 47, 261—227.
- , 1969: Infraorbital bones and their bearing on the phylogeny and geography of osteoglossomorph fishes. Amer. Mus. Novit., 2394.
- Nybelin, O., 1971: On the caudal skeleton in *Elops* with remarks on other teleostean fishes. ACTA Reg. Soc. Linn. Gothoburg. Zool., 7, 1—50.
- , 1974: A revision of the leptolepid fishes. ACTA Reg. Soc. Linn. Gothoburg. Zool., 9, 1—202.
- Patterson, C. and D. E. Rosen, 1977: Review of the ichthyodectiform and other Mesozoic teleost fishes and the theory and practice of classifying fossils. Bull. Amer. Mus. Nat. Hist., 158, Art 2, 81—172.
- Patterson, C., 1981: The development of the North American fish fauna a problem of historical biogeography. In Greenwood, P. H.; and P. L. Forey (eds.): The Evolving Biosphere. London, Brit. Mus. Nat. Hist., Chapter 20, 265—281.
- Pielou, E. C., 1979: Biogeography. Printed in U. S. A..
- Ridewood, W. G., 1904: On the cranial osteology of the fishes of the families Mormyridae, Notopteridae and Hyodontidae. Journ. Linn. Soc. (Zool.), 29, 188—217.
- Saito, K., 1936: Mesozoic leptolepid fishes from Jehol and Chientao, Manchuria. Rep. 1st Scient. Exped. Manch., Sect. 2, 1—23.
- Takai, F., 1943: A monograph on the lycopterid fishes from the Mesozoic of Eastern Asia. Journ. Fac. Sci. Tokyo, Sect. 2, 6, 207—270.
- Taverner, L., 1977: Osteologie, Phylogenese et systematique des teleosteens fossiles et actuels du super-ordre des osteoglossomorphes. Premiere Partie. Acad. Roy. Belg. Mem. Classe des Sci., T. XLII, Fasc. 3, 1—235.
- , 1978: Osteologie, phylogenese et systematique des teleosteens fossiles et actuels du super-ordre des osteoglossomorphes. Deuxieme Partie. Acad. Roy. Belg. Mem. Classe des Sci., T. XLII, Fasc. 6, 1—213.
- , 1979: Osteologie, phylogenese et systematique des teleosteens fossiles et actuels du super-ordre des osteoglossomorphes. Troisieme Partie. Acad. Roy. Belg. Mem. Classe des Sci., T. XLIII, Fasc. 3, 1—168.
- Wilson, M. V. H., 1978: *Eohiodon woodruffi* n. sp. (Teleostei, Hiodontidae) from the Middle Eocene Klondike Mountain Formation near Republic, Washington. Canad. Journ. Earth Sci., 15(5), 679—686.
- Whitehouse, R. H., 1910: The caudal fin of the teleostomi. Proc. Zool. London, 1910, 590—625.

A NEW GENUS OF HIODONTIDAE FROM LUOZIGOU BASIN, EAST JILIN

Li Guoqing

(*Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica*)

Key words East Jilin; Early Cretaceous; Hiodontidae; *Yanbiania*

Summary

Manchurichthys (Saito, 1936) has been, for a long time, the only representative of fossil vertebrate known from the Oil-bearing member of Dalazi Formation, Luozigou Basin, East Jilin. Since 1978, some new materials have been collected there by the Regional Geological Brigade of Jilin Province and the present author. Two more forms of fossil fishes are not known to occur in the rocks of this section. One is *Sinamia luozigouensis* (Li, 1984) which is referred to Amiiformes; the other, *Yanbiania* (gen. nov.), is described in this paper and included in the osteoglossomorphan family Hiodontidae.

Description

Superorder Osteoglossomorpha

Order Hiodontiformes Taverne, 1977

Family Hiodontidae

Genus *Yanbiania* gen. nov.

Diagnosis Body fusiform. Cephalic lateral-line canal system similar to that in palaeoniscids; supraorbital canal ending in the lateral-posterior part of parietals and inconnecting with that of infraorbital. Parietals large, each with a groove in shape of "r" backwards on surface and a conical lateral-posterior corner. Frontals large. One antorbital and six in fraorbitals. Supraorbital absent. Parasphenoid sturdy with big conical teeth on its ventral margin, one row in the front and two or more rows in hinder part. Supramaxilla not present. Mouth cleft deep. Coronal process of dentary undeveloped. Teeth on the maxilla, premaxilla and dentary numerous and sharp cones in shape. Operculum large; posterior margin of the lower limb of preoperculum protruding backwards and splitting into the comb-like. Number of branchiostegals about 7 pairs. Basihyal tooth plate fusiform from dorsal view and with strong teeth around its margin. Vertebrae numbered from 44 to 46; supraneurals and epineurals present. Pectoral fin lowly situated and not extending to pelvic fin. Pelvic fin abdominal, smaller than the former. Origin of the dorsal fin in advance of the anal. Dorsal and anal fins approximately equal in size and in same shape. Both lower and upper lobes of the caudal fin having eight branched and one unbranched principal rays. Caudal skeleton on the whole as in that of *Eohiodon* and *Hiodon*, with two ural centra articulating seven hypurals. Uroneurals slender and numbered in 3 or 4, the most anterior one extending forwards on to

the third pre-ural centrum. Single epural. Neural spine complete on the first pre-ural but absent on the first ural. Scales cycloid with basal radii.

Type Species *Yanbiania wangqingica* gen. et sp. nov.

Figs. 2—4; Plates. 1—III

Diagnosis Same as that for the genus, with body length to body depth ratio 3.5 to 4.2, head length to head depth approximately 1.2, predorsal length to body length ratio about 0.6 to 0.7. Vertebrae 22 or 23+22 or 23 (total 44 to 46). Fin rays: P 12; V 7; D iv, 11—12; A v, 11—12; C i, 8, 8, i, with about 12 and 10 precurent rays before the upper and lower unbranched principal rays respectively.

Holotype V6767. 1. a nearly complete fish (temporal and orbital regions damaged) (Pl. I).

Referred specimens Seven individuals with nearly complete external form but skull damaged (V6767-2, V6767-3, V6767-4, V6767-5, V6767-6, V6767-7 and Luo: 85001); two incomplete fish (V6767-8, V6767-9); one damaged skull (V6767-12); one single operulum (V6767-10) and a pair of cleithrum (V6767-11).

Horizon and locality Oil-bearing Member of Dalazi Formation, Luozigou Basin, Wangqing County, Jilin Province.

Remarks It is notable that *Yanbiania wangqingica* gen. et sp. nov. has been discovered with *Sinamia luozigouensis* (Li, 1984), associated with them are mussel-shrimp *Cyprois* and plant *Pseudofrenelopsis* and *Ruffordia*. Above and under them is euteleost *Manchurichthys* (Chang et al., 1977). Judging from the age of the above mentioned symbiotic organisms, *Yanbiania wangqingica* can be considered to be living in the Early Cretaceous, and possibly existing until early Late Cretaceous.

Comparison and Discussion

1. The new genus seems like *Lycoptera* and *Tongxinichthys* (Ma, 1980) in the respects of the invisible of the supraoccipital from above, the linkage between the maxilla and premaxilla, the architecture of the joint surface for the quadrate in the lower jaw, and six infraorbitals. But it is almost identical to *Eohiodon* and *Hiodon* in having the same pattern of the caudal skeleton (Fig. 4), a fusiform basihyal tooth plate with teeth mainly developing around its margin, the supraorbital and supramaxilla absent, radii present only on the anterior part of the scales and etc.. However, it is easy to distinguish *Yanbiania* from the above genera in the following characters:

- 1) The dorsal fin being similar to anal fin in shape and size.
- 2) The lateral-posterior corner of the parietal protruding backwards as a conical process. And there is a "r"-like groove on each of the parietal surfaces.
- 3) The outline of the frontal being like rectangle. And its part over the orbital is not obviously narrower.
- 4) The premaxilla having a high hillock-like process on its dorsum.
- 5) The operculum nearly in the shape of a parallelogram; the posterior margin of the lower limb of the preoperculum protruding backwards and splitting into the comb-like.
- 6) Teeth on the jaws more numerous and being pointed cones.
- 7) The supraorbital sensory canal ending on the lateral posterior part of the parietals.

According to these differences, *Yanbiania* is considered to be a new genus of primitive osteoglossomorphs.

2. Greenwood (1970) considered that the genera compared here with *Yanbiania* are closely related to each other. *Lycoptera* is an extinct form living in East Asia during the Late Mesozoic (Late Jurassic to Early Cretaceous). *Hiodon* is a living osteoglossomorph found only in the fresh water rivers and lakes of North America. *Eohiodon* used to be treated as a fossil representative of Hiodontidae, and has only been found from the Eocene deposits in Canada and the United States (Cavender, 1966; Wilson, 1978; Grande, 1979, 1984). But it seems impossible that *Eohiodon* is the earliest member of Hiodontidae because its skeleton is almost identical to that of *Hiodon*. Chang and Chou (1976) described a genus *Plesiolycoptera* from the middle Cretaceous of Daqing Oil Field. This genus is certainly very close to *Eohiodon* and *Hiodon* in having five infraorbitals (Fig. 7), longer anal fin base and no supramaxilla and supraorbital. According to the common characters and distributions of the mentioned genera, Chang and Chou gave a diagram of *Lycoptera*-*Plesiolycoptera*-*Eohiodon*-*Hiodon* in terms of the cladistic dispersal method.

Table 2 shows that *Yanbiania* is one of the members of the system of *Lycoptera*-*Hiodon*, and that the relationship between *Yanbiania* and *Eohiodon* plus *Hiodon* is probably closer than that between *Yanbiania* and *Lycoptera*. Such a corollary can be supported by the following clues: Some of the characters shared by the Recent *Hiodon* and the Eocene *Eohiodon* might have been derived from the level of *Yanbiania*, such as: the unique caudal skeleton which may be different from almost all of the other teleosts (Whitehouse, 1910; Gosline, 1960; Greenwood, 1966; Nybelin, 1971, 1974; Patterson et Rosen, 1977; Grande, 1985); the fusiform basihyal tooth plate with teeth mainly developing around its margin; the numerous teeth growing on the parasphenoid and jaws; having no supraorbital and supramaxilla and etc.. All of these features occurred to me that *Yanbiania* is probably one of the earliest members of Hiodontidae. Its discovery from East Jilin bridges the gap between *Lycoptera* and *Plesiolycoptera*, and provides us with some new information about the origin of the North American hiodontids.

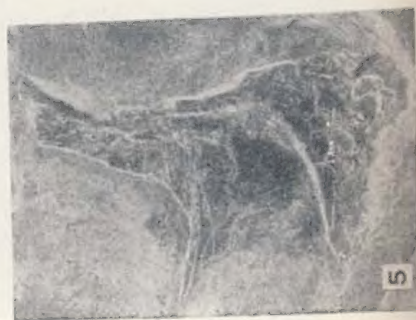
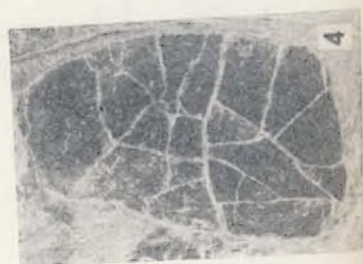
3. Nelson (1969) suggested that "the presence of osteoglossomorphs (Hiodontidae) in North America may be considered secondary and of relatively late occurrence". According to this hypothesis, hiodontids reached North America possibly by two episodes of dispersal, one from Africa to Asia, and one from Asia to North America (Patterson, 1981). It seems to me that this suggestion can not properly interpret the historical causes of the development of the Recent distribution of *Hiodon*. Greenwood (1970), Chang and Chou (1976) proposed another hypothesis based on the study of the fossil *Lycoptera*, *Plesiolycoptera* and the living *Hiodon*. They supposed that the North American Recent *Hiodon* originated from East Asia because *Lycoptera*, *Plesiolycoptera* and *Hiodon* are close related to each other on the main skeleton characters.

It is well known that *Lycoptera* has only been found in the Late Mesozoic fresh-water deposits of North China, Mongolia and East Siberia (east of Baikal Lake), approximately from 35°—60°N, and from 95°—135°E. The recently found genera *Tongxinichthys*, *Plesiolycoptera* and *Yanbiania* (gen. nov.) are all within this area (Fig. 8). Fossil localities of Eocene *Eohiodon* remain within the confines of Western North America (Cavender, 1966; Wilson, 1978; Grande, 1979, 1984). Living *Hiodon* occupies the innercontinental fresh waters of North America (Fig. 8). These evidences reveal that the range of distribution of the system of *Lycoptera*-*Hiodon* has moved from west to east gradually with the evolution of *Lycoptera*-*Yanbiania*-*Plesiolycoptera*-*Eohiodon*-*Hiodon*. And it is reasonable to bring out the corollary of

the origin of *Hiodon* in East Asia.

The evolution of *Lycopera*—*Hiodon* lasted a long time from the Late Jurassic to Recent. According to modern plate tectonics theory, East Asia was separated from Europe by Turgui Strait, and from India and Africa by Tethys Sea during the period of Late Jurassic to Late Cretaceous (Pielou, 1979) (This was the time when *Lycopera*, *Yanbiania* and *Plesiolycoptera* existed). These barriers existing until the Early Tertiary stopped *Lycopera* and its descendants from dispersing into Europe, Africa and India, and this may be the main reason why we have not found fossil teleost which can be compared with *Lycopera*, *Yanbiania* or *Plesiolycoptera* from those continents thus far.

From the distribution (both time and ranges) of *Lycopera*, *Yanbiania*, *Plesiolycoptera*, *Eohiodon* and *Hiodon*, we can draw an inspiration that it might be by the time of Late Cretaceous and Early Tertiary when the descendants of *Lycopera* or *Yanbiania* settled in North America. In other words, there was a connection between Northeast Asia and Northwest North America by the transition period from Late Cretaceous to Early Tertiary. The connection could not be island chain or stepping stone islands because such a kind of "joins" between two continents is still separated by sea. For birds, insects and wind-dispersed plants, island chain or stepping stone islands may form an easy dispersal route, but it may be completely impassable for freshwater fishes. The "join" linking up the bodies of fresh water between Northeast Asia and Northwest North America must be the land bridge or the overland water route which provided a dispersal way for the descendants of *Lycopera* or *Yanbiania*. Considering the changes of the distribution areas of fossil *Lycopera*, *Yanbiania*, *Plesiolycoptera*, *Eohiodon* and living *Hiodon*, it is credible that there was a "Bering Land Bridge" between Northeast Asia and Northwest North America during the time of Late Cretaceous and Early Tertiary.

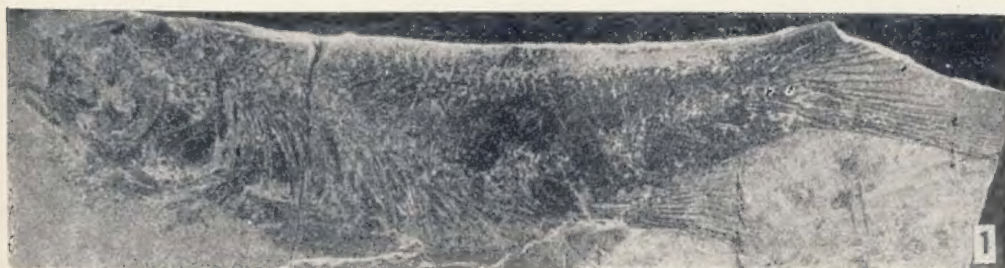


汪清延边鱼(新属、新种)

1. 示眶下骨和颌骨, 左侧视, V6767. 9, $\times 2$; 2 主要示副蝶骨和鳃盖系各骨, V6767. 8, $\times 2$; 3 主要示基舌骨齿板(白三角所指者)及前鳃盖骨, V6767. 2, $\times 3$; 4 鳃盖骨, V6767. 10, $\times 2$; 5 一对匙骨, V6767. 11, $\times 1$
 Skull of *Yanbiania wangqingica* gen. et sp. nov. 1. Showing infraorbitals and jaws; 2. Showing parasphenoid and opercular system; 3. Tooth plate of basihyale, preoperculum; 4. A broken operculum; 5. A pair of cleithrum



汪清延边鱼(新属、新种),正型标本,右侧视, V6767.1, $\times 1.5$
The Holotype of *Yanbiania wangqingica* gen. et sp. nov., right side view



汪清延边鱼(新属、新种)。三条外形近于完整的鱼,主要示体形、躯干部骨骼和鳍的位置。1V6767.2, $\times 1.5$; 2 V6767.7, $\times 2$; 3 罗: 85001, $\times 0.8$

Yanbiania wangqingica gen. et sp. nov. Three nearly complete fish, showing body shape, trunk skeleton and fins.